ORIGINAL RESEARCH ARTICLE

Medication Adherence and Its Associated Factors Among Type II Diabetes Mellitus Patients Presenting to Health Centres in Tirupati, Andhra Pradesh, India

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ABSTRACT

Background: Diabetes is a swiftly expanding health issue. To avoid or postpone the development of complications, patients need to adherent to their antidiabetic drugs. The objective was to assess medication adherence and to determine the association between medication non-adherence and socio-demographic characteristics, co-morbidities, and self-care and medication practices among Type II Diabetes Mellitus patients.

Methods: An analytical cross-sectional study was conducted among 216 diabetic patients of more than 18 years of age with duration at least 6 months presenting to the 4 health centres in Tirupati. Medication adherence was assessed using the nine-item Hill-Bone Medication Adherence Scale (HBMAS).

Results: The study found that among the 216 participants, 82.9% were adherent while 17.1% were non-adherent to medications. On multivariate analysis, age group of >60 years (AOR=2.97(95% CI 1.158-7.662), belonging to rural areas (AOR=22.163 (95% CI:2.404-193.678), not following any dietary modifications (AOR= 2.976 (95% CI 0.935-9.479) and dependent on family member for medication intake remembrance (AOR=6.103(0.875-42.546) were found to be more at risk for non-adherence.

Conclusions: One-fifth of the study participants were non-adherent to medications. Increasing age, rural population, not following dietary modifications, and dependent on family members to remind them for medication intake were found to be associated with medication non-adherence.

Keywords: Type 2 Diabetes Mellitus, Medication Non-adherence, Hill-Bone Medication Adherence Scale, Primary health centres, Secondary health centres

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INTRODUCTION

Diabetes is a chronic metabolic disease characterized by elevated levels of blood glucose which leads over time to serious damage to the heart, blood vessels, eyes, kidneys, and nerves. Type 2 diabetes, the most common form, is characterized by insulin resistance or inadequate insulin production.[1]

Diabetes is a growing health issue in low- and middle-income countries like India[2], with over 77 million cases, a number expected to rise to 134 million by 2045[3]. According to the WHO, 422 million people globally have diabetes, causing 1.5 million deaths annually.[1] India has a prevalence rate of 13.5% in males and 11.4% in females[4], earning it the title of the "diabetic capital of the world" as the disease reaches pandemic proportions.[5] Type 2 diabetes mellitus (T2DM)-related morbidity and mortality are still rising globally, despite recent advancements in diagnosis and treatment.[6,7]

However, the current disparity in diabetes prevalence between rural and urban areas in India is fast closing.[8] Medication adherence among patients, especially those residing in rural regions, continues to be a major concern despite improvements in public healthcare facilities. According to India's most recent National Non-Communicable Disease Monitoring Survey (NNMS 2017–18), only 26% of rural diabetes patients adhered to prescribed oral medications, 4.9% to insulin, and this survey also found only 13.5% of rural diabetes patients had controlled blood glucose levels.[9]

Effective diabetes management involves addressing lifestyle factors, monitoring blood glucose, and adhering to prescribed medications to prevent complications. Non-compliance can worsen the disease and increase hospital admissions, burdening the healthcare system.[10] The World Health Organization (WHO) defines adherence as "the extent to which a person's behaviour-taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed-upon recommendations from a health care provider".[11,12]

The Hill-Bone Medication Adherence Scale (HB-MAS) is a reliable and valid tool for assessing medication adherence in chronic conditions like diabetes, with ease of use in diverse clinical and community settings, including adaptation for different cultures and languages. The HB-MAS can be easily adapted to different cultural and linguistic contexts. This makes it suitable for use in diverse populations, including those in India.[13]

The adherence rates for diabetic patients receiving oral hypoglycemic medicines and insulin are approximately 65-85% and 60-80%, respectively.[14] Non-adherence with medication or inadequate adherence to prescribed medications is a widely recognised issue that contributes to the inadequate control of blood sugar levels.[15]

Medication non-adherence can result from factors such as ignorance, financial issues, lack of support, difficulty accessing healthcare, polypharmacy, and cultural norms, as well as disparities in healthcare availability between urban and rural areas.[16,17,18] Primary healthcare providers play a key role in educating diabetes patients about medication adherence.[10] Despite extensive literature, research on medication adherence and its factors in diabetic patients within primary and secondary healthcare settings in this region is scarce and needs further assessment.

The objectives of the study were to assess medication adherence and to determine the association between medication non-adherence and socio-demographic characteristics, co-morbidities, complications and self-care practices and medication practices among Type II Diabetes Mellitus patients.

METHODOLOGY

This was an analytical cross-sectional study conducted among patients with known Type II Diabetes Mellitus, attending the field practice areas Medical College in Tirupati, Andhra Pradesh which includes RHTC, UHTC and Community Health Centres (CHCs) for a period of 3 months between June 2024 to August 2024. The 4 centres under the Medical College were RHTC Mangalam, UHTC Gandhi Road, CHC Naravaripalli and CHC Chinnagotigallu. The Rural Health Training Centre, Mangalam serves a population of 29,953. It covers 5 subcentres, 5 panchayats and 24 villages. The Urban Health Training Centre, Gandhi Road covers a population of 30,349 & 9 Sachivalayams. Community Health Centre, Naravaripalli is situated 18 km from the medical college and covers a population of 86,000. Community Health Centre- Chinnagottugallu is located 41 kms from the Medical College and covers a population of 94,340. These health centres cover both rural and urban residents with type 2 Diabetes mellitus. Under Ayushman Bharath, these health centres are providing comprehensive health care services for non-communicable diseases like diabetes mellitus.

Adults with known Type II Diabetes Mellitus for at least 6 months and willing to participate in the study were included in the study. Patients who were too ill to participate, Patients with psychiatric disorders, and Pregnant women were excluded.

A study by Swain SP et al among adult patients with Type 2 Diabetes Mellitus attending OPD of a medical college in Odisha found that the low to medium medication adherence was 85%.[19] The sample size was calculated by using the formula: $(Z_{\alpha/2})^2$ pq/d^2 ($Z_{\alpha/2}$ at 95% confidence intervals is 1.96, p = proportion of Diabetes mellitus patients with low to medium adherence to medications, q =100-p (15%), d = Absolute Precision (5%). The sample size calculated was 196, with a 10% non-response rate of 216. The final sample size was 216.

All the consecutive patients with known Type II Diabetes Mellitus for at least 6 months who visited the centres for medical advice during the study period and were willing to participate were included for the study.

A pilot study was conducted among 10% of sample size, i.e. 22 random study participants to assess the feasibility and operational aspects of the study and the questionnaire was pre-tested and modified.

Data was collected by interviewing the study participants using a semi-structured questionnaire that contains details such as sociodemographic characteristics including age, gender (male/female), religion (Hindu/Muslim/Christian/others), Caste (OC/BC/SC/ST), Residence (rural/urban), Family type (Nuclear/Joint/Three generation), No. of family members, marital status (unmarried/married/widowed/separated/divorced), education (Illiterate/primary/secondary/higher), occupation (Employed/Retired/unemployed) and socioeconomic status (modified BG prasad classification 2024). Habits and Risk factors (smoking, alcohol consumption, tobacco consumption, any dietary modification, doing physical activity and family history of diabetes mellitus), comorbidities and complications (hypertension, thyroid disorders, asthma, tuberculosis etc and complications due to diabetes mellitus), self-care practices (self-monitoring of blood glucose and its frequency, maintaining log of blood sugar, foot care practices, utilization of follow-up services), prescription practices and medication practices (using polypharmacy, type of medication, using AYUSH medicines, source of medicine, family support in medication etc). Adherence was assessed using the nine-item Hill-Bone Medication Adherence Scale (HBMAS).[16,20,21] This is a nine-item questionnaire measuring adherence on a 4-point Likert scale. The raw score was converted to a percentage by dividing the actual score by the total possible score and multiplying the result by 100. In the study, non-adherence was considered as an HBMAS score of less than 80%.[6]

This study was approved by the Institutional Ethics Committee of SVIMS (Roc.No.AS/11/IEC/SVIMS/2017 vide IEC No: 1680 dated 01.08.2024). Informed written consent was obtained from each study participant after explaining about the study and confidentiality was ensured.

Data entry was done in Microsoft excel 2019 (Windows Corporation, Redmond, WA) and analysis was done using the software SPSS (statistical package for social sciences, IBM SPSS statistics for windows, version 26.0. Armonk, NY:IBM corp). Categorical variables were presented as absolute numbers and percentages. Categorical variables were analyzed using chi-square test or Fisher's exact test as appropriate. Variables with p value less than 0.02 (independent variables) on bivariate analysis were included in the multivariate analysis. A multivariate logistic regression analysis was conducted to examine the association between medication non adherence (dependant variable) and independent variables, adjusting for potential confounders. The odds ratios (ORs) and 95% confidence intervals (CIs) were estimated for each independent variable. For all statistical tests, p-value less than 0.05 was considered as significant.

RESULTS

A total of 216 Type 2 Diabetes Mellitus patients were included in the study. Among them, the majority were <60 years (63.8%), males (51.6%), belonging to Hindu religion (87%) and OBC caste (45.4%), residing in rural areas (73.1%), belonging to nuclear families (75.9%) with family size <5 (75.0%). Majority of the participants were married (84.7%), educated up to primary (44.4%), unemployed (45.8%) and belonging to upper middle socio-economic status 71(32.9%). (Table 1)

In this study, it was found that among the 216 participants,179(82.9%) were adherent to medications while 37(17.1%) were non-adherent to medications.

As shown in the table 2, age group > 60 years 20(25.6%), rural population 36(22.8%) and family size >5 16(29.6%) were more non-adherent to medications than their counterparts. These factors were found to be statistically significant. (Table 1)

It was observed that those who didn't follow any dietary modification 32(20.6%) were found to be more non-adherent compared to their counterparts who follow dietary modification 5(8.2%). It was found to be statistically significant. Patients with complications were more nonadherent compared to patients without complications (31.6% vs 14%). (Table 2)

It was observed that patients who were utilizing follow up services from both public and private sector were more nonadherent compared to utilizing public sector alone. (37.5% vs 13.6%). Among those who were taking both oral hypoglycemic drugs and insulin (40.0%) were more non-adherent compared to those who were taking only oral hypoglycemic drugs or insulin which were 13.6% and 33.3% respectively. Those who procure their drugs from both private and government pharmacy (37.5%), those who buy their medications by both themselves and their family members (37.8%) and those dependent on their family members to remind them for medication intake (38.5%) were more non-adherent to medications compared to their counterparts. (Table 3)

As shown in the table 4, study participants of age group >60 years were found to be 2.97(95% CI 1.158-7.662) times more at risk for medication non-adherence compared to those < 60 years. Those belonging to rural areas were found to be 22.163(95% CI:2.404-193.678) times more at risk for medication non-adherence compared to those belonging to urban areas. Those with family size of >5 was found to be 2.171(95% CI 0.857-5.501) times more at risk for medication non-adherence compared to those with family size <5.

Table 1: Association between medication non adherence and socio-demographic profile

Socio demographic variables	Medication non-adherence (n=37) (%)	Medication adherence (n=179)(%)	Total	p-value
Age group				
<60 years	17(12.3)	121(87.7)	138	0.01
>60 years	20(25.6)	58(74.4)	78	
Gender				
Female	16 (15.4)	88(84.6)	104	0.51
Male	21(18.8)	91(81.3)	112	
Religion				
Hindu	35(18.6)	153(81.4)	188	0.21
others	2(7.1)	26(92.9)	28	
Caste				
General	13(16.9)	64(83.1)	77	0.48
OBC	16(16.3)	82(83.7)	98	
SC/ST	8(19.5)	33(80.5)	41	
Residence				
Urban	1(1.7)	57(98.3)	58	0.00
Rural	36(22.8)	122(77.2)	158	
Family structure				
Nuclear	28(17.1)	136(82.9)	164	0.75
Joint	4(13.8)	25(86.2)	29	
Extended	5(21.7)	18(78.3)	23	
No. of family members				
<5	21(13.0)	141(87.0)	162	0.005
>5	16(29.6)	38(70.4)	54	
Marital status				
Unmarried	1(16.7)	5(83.3)	6	0.75
Married	30(16.4)	153(83.6)	183	
Widowed/ Separated	6(22.2)	21(77.8)	27	
Education				
Illiterate	10(17.9)	46(82.1)	56	0.85
Primary	18(18.7)	78(81.2)	96	
Secondary	8(16.3)	41(83.3)	49	
Higher	1(6.7)	14(93.3)	15	
Occupation				
Employed	11(12.0)	81(88.0)	92	0.19
Retired	6(24.0)	19(76.0)	25	
Unemployed	20(20.2)	79(79.8)	99	
Socio-economic status				
Upper	11(22.0)	39(78.0)	50	0.34
Upper middle	15(21.1)	56(78.9)	71	
Middle	4(8.7)	42(91.3)	46	
Lower middle	6(15.8)	32(84.2)	38	
Lower	1(9.1)	10(90.9)	11	

Table 2: Association between medication nonadherence and habits, risk factors, comorbidities and complications

Risk factors/habits/ comorbidities/complications	Medication non-adherence (n=37) (%)	Medication adherence (n=179)(%)	Total	p-value
Smoking				
Ex smoker	5(23.8)	16(76.2)	21	0.42
Non smoker	25(15.2)	139(84.8)	164	
Current smoker	7(22.6)	24(77.4)	31	
Alcoholic	7(13.5)	45(86.5)	52	0.42
Tobacco chewer	3(13.0)	20(87.0)	23	0.58
Dietary modification	5(8.2)	56(91.8)	61	0.02
Doing Physical activity	6(13.6)	38(86.4)	44	0.49
Family history of diabetes	23(21.3)	85(78.7)	108	0.10
Hypertensive	15(15.6)	81(84.4)	96	0.60
Thyroid disorders	2(16.7)	10(83.3)	12	0.96
Asthma	2(20.0)	8(80.0)	10	0.80
Tuberculosis	0(0)	4(100)	4	0.35
Complications	12(31.6)	26(68.4)	38	0.04

Table 3: Association between medication adherence and self-care practices and medication practices

Self-care practices and medication practices	Medication non-adherence (n=37) (%)	Medication adherence (n=179)(%)	Total	p value
Self-monitoring of blood glucose				
Yes	2(8.7)	21(91.3)	23	0.25
No	35(18.1)	158(81.9)	193	
Frequency of self-monitoring				
Daily	1(20.0)	4(80.0)	5	0.71
Weekly	0(0)	3(100)	3	
Fortnight	0(0)	4(100)	4	
Monthly	1(9.1)	10(90.9)	11	
Log of blood sugar values				
Yes	2(20.0)	8(80.0)	10	0.34
No	1(7.1)	13(92.9)	14	
Self-care of foot				
Yes	12(14.8)	69(85.2)	81	0.48
No	25(18.5)	110(81.5)	135	
Follow up				
Public sector	25(13.6)	159(86.4)	184	0.00
Both public and private sector	12(37.5)	20(62.5)	32	
Polypharmacy				
Yes	9(13.8)	56(86.2)	65	0.40
No	28(18.5)	123(81.5)	151	
Type of medication				
Both	8(40.0)	12(60.0)	20	0.004
Oral hypoglycemic drugs	25(13.6)	159(86.4)	184	
Insulin	4(33.3)	8(66.7)	12	
Alternative medication (AYUSH)				
Yes	2(12.5)	14(87.5)	16	0.60
No	35(17.5)	165(82.5)	200	
Procurement of drugs				
Both	9(37.5)	15(62.5)	24	0.01
Government pharmacy	26(14.9)	149(85.1)	175	
Private pharmacy	2(11.8)	15(88.2)	17	
Who buys the medications				
Both	14(37.8)	23(62.2)	37	0.001
Self	17(11.3)	133(88.7)	150	
Family members	6(20.7)	23(79.3)	29	
Who reminds for medication intake				
Both	10(26.3)	28(73.7)	38	0.01
Self	22(13.3)	143(86.7)	165	
Family members	5(38.5)	8(61.5)	13	

It was found that those who were not following any dietary modifications were 2.976 (95% CI 0.935-9.479) times more at risk for medication non-adherence compared to their counterparts.

Patients using only oral hypoglycemic drugs were 73% (AOR-0.263(95% CI 0.063-1.103) lesser chance of non-adherence to medication compared to patients using both. Those who buy the medication by themselves were 70% (AOR-0.303, 95% CI:0.070-1.300) lesser chance and those who are dependent on their family members to buy their medications were 73% (AOR-0.266, 95% CI (0.042-1.688) lesser risk for medication nonadherence. Procuring drugs from government pharmacy 1.397(0.293-6.667) and dependent on family member for medication intake remembrance 7.611(1.124-51.561) were more at odds for the development of medication non-adherence. (Table 4)

DISCUSSION

This study was conducted to estimate medication non adherence and to determine the association between medication non-adherence and socio-demographic characteristics, co-morbidities, complications and self-care practices and medication practices among Type II Diabetes Mellitus patients.

This study revealed that 17.1% of the total participants were non-adherent to the medications. This finding was similar to the finding in the study done in Ghana by Afaya RA et al in which non adherence rate was 15.5%.[22] In this study, the observed non-adherence rate was significantly lower than the rates reported in similar studies conducted in Odisha by Swain et al. (85%)[19] and Sahoo et al. (65.66%)[18] and Abhisek Mishra et (32.9%).[6] This difference might be due to using different medication adherence scale

Table 4: Multivariate Binary logistic regression to predict the risk of non-adherence to medication

Variable	Unadjusted Odds ratio OR (95% CI)	Adjusted Odds ratio OR (95% CI)	P value
Age group			
< 60 years	1	1	-
> 60 years	2.454(1.197-5.034)	2.979(1.158-7.662)	0.024
Residence			
Urban	1	1	-
Rural	16.820(2.250-125.74)	22.163(2.404-193.678)	0.006
Number of family members			
<5	1	1	-
>5	2.827(1.345-5.940)	2.171(0.857-5.501)	0.102
Dietary modifications			
Yes	1	1	-
No	2.914(1.078-7.874)	2.976(0.935-9.479)	0.065
Type of medication used			
Oral hypoglycemic drugs	0.236(0.088-0.634)	0.263(0.063-1.103)	0.068
Insulin	0.750(0.168-3.351)	0.372(0.050-2.778)	0.336
Both	1	1	-
Procurement of drugs			
Government pharmacy	0.291(0.115-0.734)	1.397(0.293-6.667)	0.852
Private pharmacy	0.222(0.041-1.206)	0.797(0.080-7.980)	0.378
Both	1	1	-
Who buys the medications			
Self	0.210(0.091-0.484)	0.303(0.070-1.300)	0.108
Family members	0.429(0.140-1.310)	0.266(0.042-1.688)	0.160
Both	1	1	-
Who reminds for medication intake			
Self	0.431(0.184-1.008)	1.463(0.392-5.465)	0.571
Family members	1.750(0.463-6.619)	6.103(0.875-42.546)	0.852
Both	1	1	-

and study population was included from different socio economic background. The implementation of government-sponsored free drug distribution programs in public health centres may account for the lower level of non-adherence seen among our study participants in comparison to other studies.

Our study found that individuals of age > 60 years were not adherent to the prescribed treatment. This finding aligns with the study conducted in Cameroon by Aminde et al [23], but contradicts the results of the study by Afaya RA et al,[22] which reported a significant prevalence of non-adherence among younger individuals. The lack of adherence in this older age group maybe due to factors such as forgetfulness, financial constraints, medicine side effects, or the remission of symptoms.

In this study, the majority of rural residents had poor adherence compared to urban residents (22.8% vs 1.7%). This finding is similar to the study done in Bangalore by Padmanabha URS et al.[24] This might be due to low education levels, lower household income and other barriers to accessing healthcare. Thus, there is a need to properly educate the patients about chronic nature of disease and its lifelong treatment, its complications, the need for adherence of treatment, side effects of treatment, and addressing their myths. To increase treatment adherence, the drugs can be administered in those locations once a month in mobile camps. Patients can receive assistance and information by enlisting the help of social workers and community health workers, especially in rural areas.[25]

According to our study, medication non-adherence was higher among individuals (86.5%) who do not adhere to any dietary modifications. These results align with the findings in the study conducted by Sahoo et al,[18] which shown that adhering to a diabetic diet was correlated with improved medication adherence. Mishra et al. found that patients with poor dietary practices and inadequate physical activity had a higher chance of non-adherence. This could be because individuals exposed to unhealthy lifestyles are likely to exhibit poor adherence to their prescribed medication, as the clustering of unhealthy behaviours is an observed phenomenon.

It was found that those who buy their medications by themselves were more adherent. It may be because of their independence and awareness regarding the disease. Those who are dependent on their family members to remind them for medication intake were more at risk for medication non-adherence. These findings were found to be similar to the findings found in the study done by Mishra A et al.[6] Forgetfulness has repeatedly been recognised in various studies as a contributing factor to non-compliance with medicines.[26,27] This is likely because patients are not receiving sufficient health information or lacking suitable family support. In order to mitigate patient forgetfulness, it is imperative to implement a more frequent schedule of follow-up visits, conduct counselling sessions that involve a family member, and

even organise peer group initiatives.[28] The involvement of community health workers in conducting home visits for health education is expected to have a substantial impact on medication adherence, enhance glycaemic management, and improve overall health outcomes.

Strength and Limitations

The strength of the study is that it is a centre-based study done in both primary and secondary health centres, thus the findings are applicable to all the patients attending the both primary and secondary health centres. Limitation of this study was the inclusion of only patients who physically visited the centres, whereas those who did not attend were omitted from the study. Similarly, as we have gathered self-reported data on medication adherence, there is a potential inclination to overstate or understate adherence because of recall biases. The use of consecutive sampling poses a significant constraint, since it results in potential participants lacking an equal opportunity to be included in the study.

Conclusion

The study concluded that about one-fifth of the study participants were non-adherent to medications. Increasing age, rural population, not following dietary modifications, dependent on family members to remind them for medication intake were found to be associated with medication non-adherence. The findings imply that, notwithstanding advancements in the provision of healthcare services at the grassroots level in India, non-adherence generally continues to pose a problem for the health system. As a result, diabetes patients require counselling and treatment that is tailored to them individually, with a focus on shared decision-making between patients and physicians. Strengthening patient education programs within the public healthcare delivery system and introducing a fixed-dose combination of anti-diabetic medications should be among the top policy priorities. Incorporating medication adherence evaluations into standard NCD care can significantly advance the health system's efforts to enhance clinical outcomes for people with type 2 diabetes. Health awareness campaigns may be planned and play a vital role in improving patient adherence levels. Health care providers should address medication adherence challenges, educate diabetics to increase their knowledge in collaboration with all stakeholders, including the media and nongovernmental organizations.

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Authors' Contributions

All the authors have contributed to the study's conceptualization, data curation, formal analysis, methodology, software, supervision, validation, visualization, original draft writing, and writing review & editing. All authors edited and approved the final version of the manuscript.

Availability of Data

The data can be available from the corresponding author upon reasonable request.

Generative AI tools were not used to prepare the manuscript.

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